CLAIMS

1. Apparatus (10) for establishing the positions of metal objects in a mixed input stream of both metal and non-metal objects, the apparatus comprising a differential metal-detecting coil (14A) having a first coil portion (15) wound in a first sense and a second coil portion (16) of generally similar shape and size to the first, wound in a second sense opposite to the first sense, and conveying means (11) for moving objects with respect to, and past, the differential metal-detecting coil in a plane and in a direction with unit vector $\hat{\mathbf{a}}$, characterised in that the second coil portion is displaced from the first coil portion by a displacement **B** having a component in the plane in a direction with unit vector $\hat{\mathbf{b}}$, wherein $0 < \cos^{-1} \hat{\mathbf{a}} \bullet \hat{\mathbf{b}} < \pi/2$, and in that the apparatus further comprises analysing means (100) for analysing the form of the output voltage of the coil as a function of time to establish the position of said metal objects in a direction $\hat{\mathbf{c}}$ in the plane, where $\hat{\mathbf{c}}$ is defined by $\hat{\mathbf{a}} \bullet \hat{\mathbf{c}} = 0$.

2. Apparatus according to claim 1 wherein $\mathbf{B} \bullet \hat{\mathbf{a}} \geq t$, where t is the dimension of a coil portion in the $\hat{\mathbf{a}}$ direction, and $\frac{s}{2} \leq \mathbf{B} \bullet \hat{\mathbf{c}} \leq s$, where s is the dimension of a coil portion in a direction with unit vector $\hat{\mathbf{c}}$ defined by $\hat{\mathbf{a}} \bullet \hat{\mathbf{c}} = 0$.

3. Apparatus according to claim 1 or claim 2 wherein the analysing means comprises means for identifying voltages of different polarities, and for ascribing voltages of a first polarity to one coil portion and voltages of a second polarity, opposite to the first, to the other coil portion.

4. Apparatus according to any preceding claim and comprising a plurality of differential metal-detecting coils arranged in a linear array substantially in the $\hat{c}$ direction.

5. Apparatus according to claim 4 and further comprising a single transmitter coil (13) arranged around the differential metal-detecting coils.

6. Apparatus according to claims 4 wherein the differential metal-detecting coils are each formed on a printed circuit board (PCB).

7. Apparatus according to claim 6 wherein the differential metal-detecting coils are formed on a single PCB.

8. Apparatus according to claim 7 wherein a single transmitter coil is formed on the PCB around the differential metal-detecting coils.

9. Apparatus according to claim 8 wherein the analysing means comprises electronic hardware co-located with said coils on the single PCB.

10. Apparatus for establishing the positions of metal objects in a mixed input stream of both metal and non-metal objects, the apparatus being substantially as hereinbefore described and illustrated in Figures 1, 2, 4 and 5.

11. Apparatus for establishing the positions of metal objects in a mixed input stream of both metal and non-metal objects, the apparatus being substantially as hereinbefore described and illustrated in Figures 1, 4, 5 and 6.

12. Apparatus for establishing the positions of metal objects in a mixed input stream of both metal and non-metal objects, the apparatus being substantially as hereinbefore described and illustrated in Figures 1, 4, 5 and 7.

13. A method of establishing the positions of metal objects in a mixed input stream of both metal and non-metal objects, characterised in that the method comprises use of apparatus according to any preceding claim.

14. A metal-detector array system comprising a plurality of differential metal-detecting coils, the array extending in a direction with unit vector $\hat{\mathbf{x}}$, and each metal-detecting coil having a first coil portion (15) wound in a first sense and a second coil portion (16) of generally similar shape and size to the first, wound in a second sense opposite to the first sense, characterised in that, in at least one metal-detecting coil, the second coil portion thereof is displaced from the first coil portion thereof by a displacement **B** such that the two coil portions are substantially in the same plane and $0 < \cos^{-1} \hat{\mathbf{b}} \bullet \hat{\mathbf{x}} < \pi/2$ where $\hat{\mathbf{b}}$ is a unit vector defined by $\mathbf{B} \bullet \hat{\mathbf{b}} = |\mathbf{B}|$, and in that the system further comprises, in respect of that or those metal-detecting coil or coils, analysing means for analysing the form of the output voltage of the coil or coils as a function of time to establish the position, along the direction $\hat{\mathbf{x}}$, of metal objects when said objects are moving past the array substantially in a direction with unit vector $\hat{\mathbf{y}}$ where $\hat{\mathbf{x}} \bullet \hat{\mathbf{y}} = 0$.